Activity #5: Lesson on Linear Equations (Teacher version)
Math

Note to students: You will work with a partner on this activity. Each student will complete his/her own worksheet.

Your name _____

Your partner's name _____

National Standards addressed:

Content Standard:

Algebra Expectations: Students will understand relations and functions and select, convert flexibly among, and use various representations for them; students will interpret representations of functions of two variables; students will write equivalent forms of equations and solve them with fluency; students will analyze change in various contexts.

Process Standards:

Communication Expectations: Students will analyze and evaluate the mathematical thinking and strategies of others; students will communicate their mathematical thinking coherently and clearly to peers, teachers, and others; students will use the language of mathematics to express mathematical ideas precisely.

Connection Expectation: Students will recognize and use connections among mathematical ideas.

Definition of linear equation:

Any equation that can be written in the form, Ax + By = C, where A and B are not both zero. This form is called standard form for linear equations.

(This is the algebra of it!)

The graph of a linear equation will be a straight line.

(This is the geometry of it!)

Easy, huh?

First, let's investigate the algebra of a linear equation.

To begin, work individually to show or explain why each equation below is or is not linear.

This means, show the algebra of it!

When you have made your responses, discuss each with your partner!

1a. 2x + 3y = 7 **Explain or show why or why not linear.**
(Yes, it is linear, because it is in the form Ax + By = C, where A and B are not both 0. Here, A = 2, B = 3, C =7.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

1b. x - 3y = 9 **Explain or show why or why not linear.**
(Yes, it is linear, because it is in the form Ax + By = C, where A and B are not both 0. Here, A = 1, B = -3, C = 9.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

1c. –6x = 5 **Explain or show why or why not linear.**
(Yes, it is linear, because it can be rewritten as –6x + 0y = 5, standard form, where A and B are not both 0. Here, A = -6, B = 0, C = 5.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

1d. 12 = -5 **Explain or show why or why not linear.**
(No, this is not a linear equation. This equation has no variables.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

1e. 5 – 2y = 0 **Explain or show why or why not linear.**
(Yes, it is linear, because it can be rewritten as 0x – 2y = -5, where A and B are not both 0. Here, A = 0, B = -2, C = -5.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

Stop now! Check your work by discussing, as a class, team results before moving ahead.

Now continue on your own checking the rest of problem 1 with your partner after you both have completed the section.

1f. y = 7x – 2 **Explain or show why or why not linear.**
(Yes, it is linear. Students should show the steps in the rewriting, 7x – y = 2.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

1g. 2x = y + 3 **Explain or show why or why not linear.**
(Yes, it is linear: 2x – y = 3.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

1h. y – 3 = 8 **Explain or show why or why not linear.**
(Yes, it is linear: 0x + y = 11.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

1i. 0x = 5 – 2y **Explain or show why or why not linear.**
(Yes, it is linear: 0x + 2y = 5.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

1j. 8 – 0y = 0x **Explain or show why or why not linear.**
(No, it is not linear, because when rewritten as 0x + 0y = 8, both A and B equal 0.)

Does your partner agree? _____
What did you and your partner finally agree, linear or not?

Now, work individually and write five equations that are linear and show or explain why. This means, show the algebra of it!
When you have made your responses, discuss each with your partner, and make any necessary changes.

Equation Does your partner agree? Make necessary changes.

2a. _____
_____

2b. _____
_____

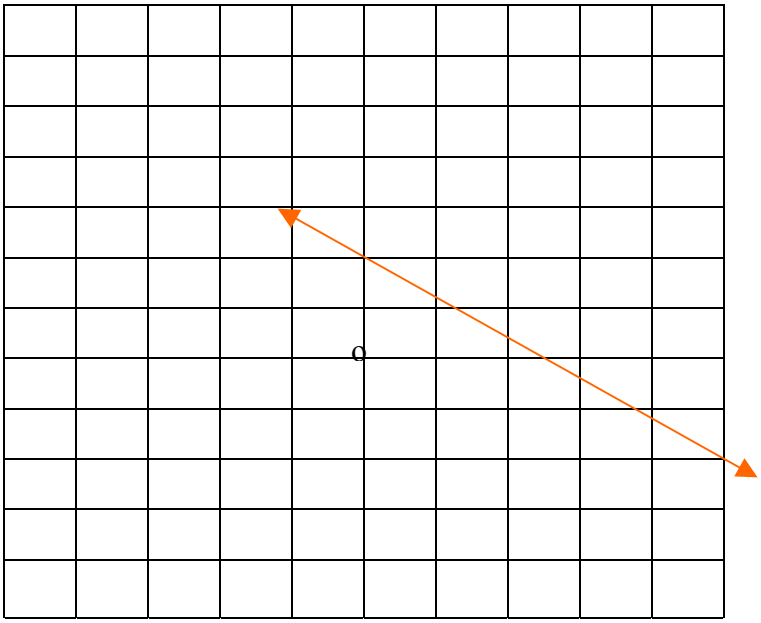
2c. _____
_____

2d. _____
_____

2e. _____
_____

Stop now! Check your work by discussing your results with another team before moving ahead.

3a. On the grid below, graph the line through the points (5, -2) and (-1, 3).



3b. Find the slope of this line algebraically.
The slope is the change in y compared to the change in x. In other words,

$$\textbf{slope} = \textbf{m} = \frac{\text{change in y}}{\text{change in x}} = \frac{y_1 - y_2}{x_1 - x_2}$$

Use -2 for y_1 and 5 for x_1. Use 3 for y_2 and –-1 for x_2.

(m = $\frac{-2-3}{5-(-1)} 2\frac{1}{2} = \frac{-5}{6}$**.**

If students need help, you might send them to the following sites:
http://www.exploremath.com/activities/activity_list.cfm?categoryID=3
or here http://www.exploremath.com/activities/Activity_pagecfm?ActivityID=45**.)**

3c. Find the slope of the line through (5, -2) and (-1, 3) by counting.

First, pick one point on the line and label it start.
Second, start there and count up or down to another point on the line.
Then, start there again and count right or left to that same other point on the line.
Remember up is + and down is -, right is + and left is -.

slope = m = ---------- = -------

(Starting with point (5, -2) and counting to point (-1, 3), m = $\frac{up\ 5}{left\ 6} = -\frac{5}{6}$**.)**

3d. Does this match your answer in 3b? Why or why not? _____

_____

_____

_____

(Yes.)

4a. Graph the line 2x + 3y = 5. To do this, you might first find three integral points.

Of course you know that two points determine a line. The third point is just a safety point --- if the three points do not line up, you've goofed with something and need to double-check your work!

To find the first point with integral coordinates, pick an integer for x, say 2. Now substitute 2 in the equation and solve for y. If y is an integer, then the point is easy to plot and you can use these coordinates.

When you substitute 2 for x, you get 2* 2 + 3y = 5.
Solving for y, you will get 4 + 3y = 5
-4 -4
3y = 1

$$y = \frac{1}{3}$$

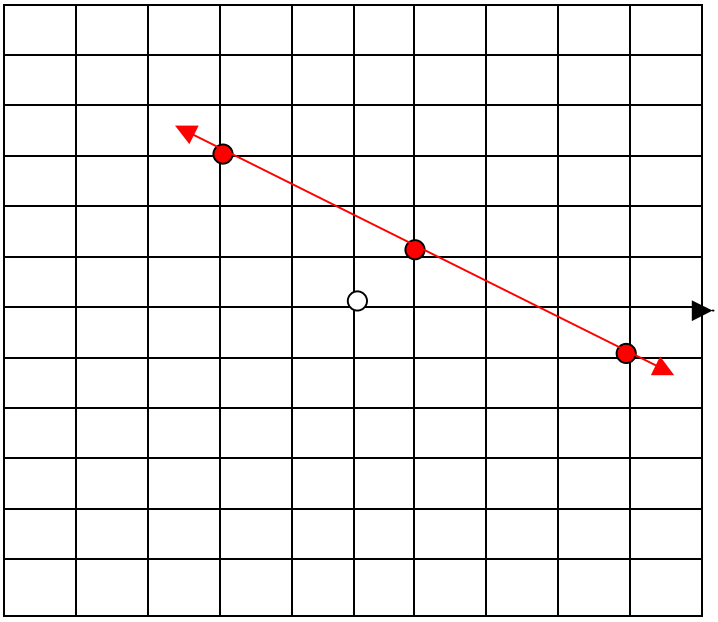
Since you did not get an integral value, you need to pick another x. Try x = 3. If 3 gives an integer for y, you will have found one point that is easy to plot. Now you repeat the process until you have three points with integers as coordinates. *It's good to be working with a partner!*

Show your work! **Put your values in the table below.**

x	y
4	-1
7	-3
10	-5

(Students will need to extend the graph below or find integral points that can be graphed on the given grid, such as ((1, 1) and (-2, 3).)

4b. Now plot the points and graph the line.



5a. Find the equation of the line that passes through (1, 2) and (-3, 4). Show your work. First, find the slope. Remember that the slope is the change in y compared to the change in x. In other words,

$$\text{slope} = m = \frac{change\ in\ y}{change\ in\ x} = \frac{y_1 - y_2}{x_1 - x_2}.$$

What is the slope? _____

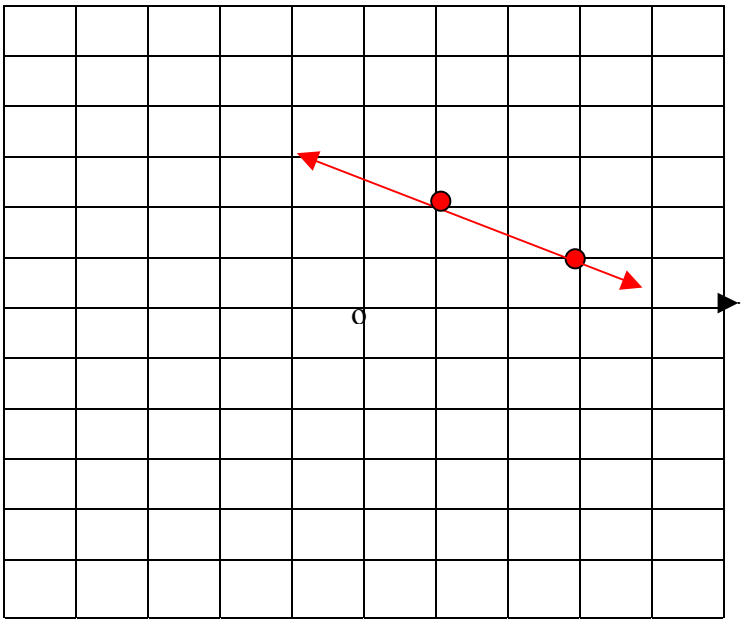
(m = $-\frac{1}{2}$**.)**

5b. Choose a point. _____ Substitute in the point-slope form for a line, $y - y_1 = m(x - x_1)$ and simplify so that the x-term and the y-term are on the same side of the equation, putting the equation in standard form. Show all work.

($-\frac{1}{2}x + y = 2\frac{1}{2}$ or equivalent form.)

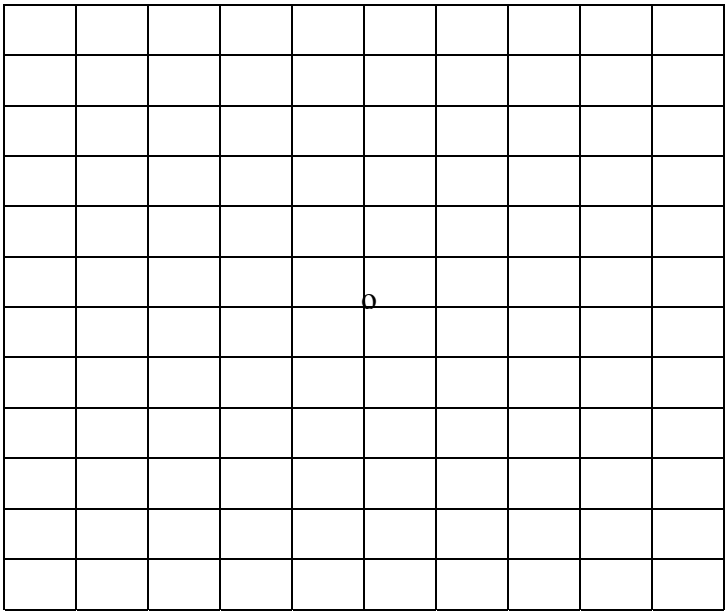
5c. What does your partner think?

5d. Graph the line on the grid below.



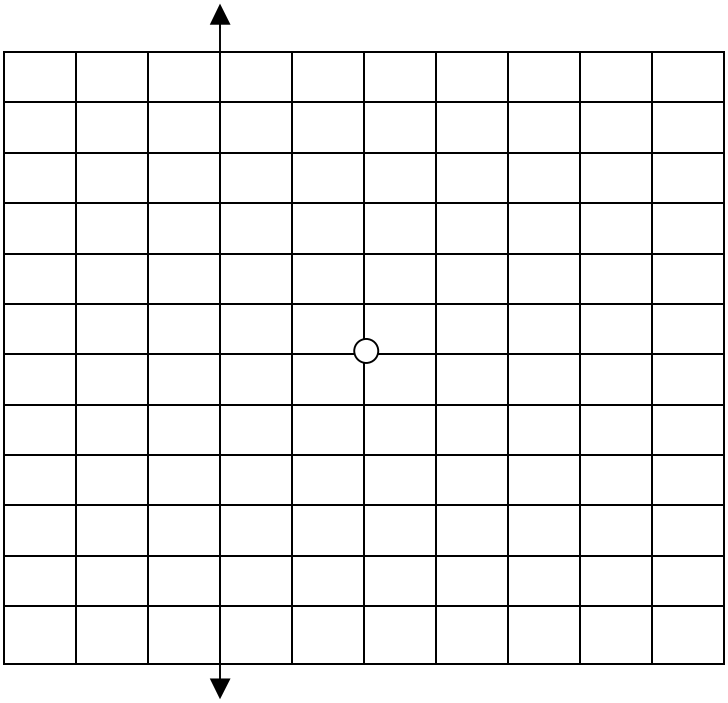
(If students need help, you might send them to the following site:
http://www.exploremath.com/activities/Activity_page.cfm?ActivityID=10**.)**

6. The graph of the linear equation, 0x + 2y = 6, contains these points: (3, 3) (4, 3) (5, 3) (6, 3) (7, 3). *Notice that all the y values are 3!* Graph this linear equation on the grid below.



(Students should have a horizontal line at y = 3.)

7. Guess the equation of the linear equation graphed below. Discuss possibilities with your partner.



What is your guess? _____

(x = -2)

8. Can you make a guess about the equation of a line through points (3, 3), (3, 4), (3, 5), (3, 6), and (3, 7)?

Your guess _____

Why do you make this guess? _____
_____

(x = 3. The reason for the guess: all the x's are 3's.

The following web sites and articles provide enrichment and support for this activity:

1. http://www.exploremath.com/activities/Activity_page.cfm?ActivityID=10
2. http://www.geom.umn.edu/
3. http://www.terragon.com/tkobrien/algebra/
4. http://standards.nctm.org/document/chapter7/conn.htm)

One Rubric for Lesson on Linear Equations

4	3	2	1
A complete, correct response with a detailed explanation.	Good solid correct response with clear explanation.	Explanation is unclear or response is incorrect.	Misses key points

Each problem will be worth 4 points.

Total possible points = 92